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PTERODACTYLES.

Dragons of the Air: an Account of Extinct Flying Reptiles. By H. G. Seeley. Pp. xiii + 239. Illustrated. (London: Methuen and Co., 1901.) Price 6s.

EVER since the study of fossil remains was taken up in earnest, pterodactyles, or, as the author elects often to call them, ornithosaurs, have attracted the deepest attention on the part of anatomists on account of the many puzzling problems connected with their organisation and affinities, while from their weird form, peculiar attributes, and the huge dimensions attained by some of their later representatives they have appealed more strongly to popular interest than is the case with many of their extinct contemporaries. Among all the diligent students of the organisation of these strange creatures (so far as it can be worked out from their bones alone) none has been more constant or more persistent than Prof. H. G. Seeley, who commenced his investigations when a student at Cambridge during the late 'sixties. At that time the so-called coprolite-works in the Cambridge Greensand were in full swing; and the rich, albeit much broken, material thus obtained afforded opportunities for studying the structural details of pterodactyle bones in a manner impossible when dealing with the embedded skeletons of the smaller forms from the lithographic limestone of the Continent. Of these opportunities—both as regards study and collecting—Prof. Seeley availed himself to the full; and from that time to this, as occasion presented itself, he has, we believe, continued faithful to his favourite study. During the latter years of Prof. Sedgwick's tenure of the Woodwardian Chair at Cambridge, Prof. Seeley delivered a series of lectures at various centres—including the Royal Institution—on pterodactyles; and the present volume purports to be a reissue of these lectures in an expanded form, with such revision as has been rendered advisable by the progress of investigation.

In this volume Prof. Seeley appeals, as he tells us in the preface, alike to the general public and to the man of science. To achieve success in this double rôle is by no means an easy matter; and it may be questioned whether he has not given too much elementary explanation to suit the latter class of readers and not enough for the needs of the former. This, however, is a matter which concerns an author and his publisher rather than a reviewer.

All who have been occupied in investigating the osteology of pterodactyles can scarcely fail to be struck with the marked similarity presented in many respects—especially in the skull and cervical vertebræ—to birds. And this avian resemblance seems to have impressed itself with peculiar force on the mind of the author, who has all along contended that these creatures are not entitled to be ranked as reptiles, but form an outstanding group by themselves, displaying very widespread affinities with other groups of animals. So widespread, indeed, does Prof. Seeley regard the relationships of pterodactyles that it is by no means an easy matter to understand what his opinions on this subject really are, especially as his

sentences are not unfrequently so involved that it is difficult to grasp his meaning. Even, however, if they cannot agree with them (or in some cases even understand them), the views of such an experienced and earnest investigator on a subject he has made specially his own should command respectful attention on the part of those whose knowledge in this respect is less extensive than that of the author.

Perhaps the best way of endeavouring to convey an idea of the author's views on pterodactyle relationship—which is the leading feature of the book—will be to quote his own words.

Selecting a few passages in serial order, we find it stated on p. 58 that¹—

"While these animals are incontestably nearer to birds than to any other animals in their plan of organisation, thus far no proof has been found that they are birds, or can be included in the same division of vertebrate life with feathered animals."

On p. 188 we are told that—

"It is not so much that they mark a transition from reptile to bird, as that they are a group which is parallel to birds, and more manifestly holds an intermediate place than birds do between reptiles and mammals."

Again, on p. 210 we find the following:—

"Therefore there is a closer fundamental resemblance between some carnivorous dinosaurs [*e.g. Coelurus*] than might have been anticipated."

On the following page it is stated that—

"The dinosaurs, like pterodactyles, must be regarded as intermediate in some respects between reptiles and birds."

Finally, on p. 223, we have the following:—

"It would therefore appear from the vital community of structures with birds, that pterodactyles and birds are two parallel groups, which may be regarded as ancient divergent forks of the same branch of animal life, which became distinguished from each other by acquiring the different condition of the skin, and the structures which were developed in consequence of the bony skeleton ministering in different ways; and with different habit of terrestrial progression, this extinct group of animals acquired some modifications of the skeleton which birds have not shown. There is nothing to suggest that pterodactyles are a branch from birds, but their relation to birds is much closer, so far as the skeleton goes, than is their relation with the flightless dinosaurs, with which birds and pterodactyles have many characters in common."

Other passages might be quoted, but the foregoing are sufficient to indicate the extreme complexity of pterodactyle relationship according to the author. Personally we must confess to a total incapacity to draw a mental picture of the relationships thus indicated; and we have also failed in the attempt to construct a diagram which will show how groups that are divergent are yet parallel.

We have also yet to learn that birds are in any respect intermediate between reptiles and mammals; while we totally fail to see how any animals can be, even in some respects, intermediate between reptiles and mammals on the one hand, and reptiles and birds on the other. That is to say, in the sense in which we understand the term "intermediate," as indicative of descent.

¹ The italics introduced into these quotations are the reviewer's.

Again, as suggestive of prejudice, we must take the strongest exception to the author's use of the expression "than might have been anticipated" in connection with the affinities between pterodactyles and dinosaurs. What right had anybody to form "anticipations"?

If the author really intends to imply that birds and pterodactyles are divergent and specialised branches from groups of reptiles which cannot yet be identified (at all events in the latter case) with any approach to certainty, we can agree with him. But this by no means implies any intimate relationship between the two branches in question, the structure of the limbs of which is alone amply sufficient, in our opinion, to demonstrate their totally different origin. In urging an affinity between birds and pterodactyles, Prof. Seeley, in addition to the (may we say superficial?) resemblances between their skulls and brains, lays stress on the fact that both have pneumatic bones. This feature is taken as an indication that pterodactyles probably possessed warm blood, from which is drawn the further inference that they were also furnished with a four-chambered heart. Even if the first inference be well founded, the second by no means follows, the author himself quoting the fact that the blood of the tunny has a temperature of 90° . And even if pterodactyles were warm-blooded and furnished with an avian type of heart, we should be none the more inclined to admit their affinity with birds.

Apparently the author takes no account of similar modes of life leading to the development of superficially similar bodily structure in totally different groups of animals, and the consequent "convergent" resemblance between them. And if this be so, his premises are so widely different from those on which the investigations of others are based that it is little wonder irreconcilable diversity of view results.

An instance of this nature occurs on p. 219, where we find the statement that "a few characters of ornithosaurs are regarded as having been *acquired*, because they are not found in any other animals, or have been developed only in a portion of the group." In one sense all characters are acquired; but the use which the author makes of the term "acquired characters" does not correspond with its ordinary scientific acceptance. From this we may perhaps infer that in other instances the signification attached to terms is different from that usually in vogue—which would account for much.

It is not, however, solely in regard to the affinities of these reptiles, as we still take leave to call them, that the author differs so much from current views. He likewise attributes to pterodactyles a bodily form quite unlike that with which they are generally credited; and one, it may be said, which makes them the most grotesque and bizarre creatures that ever walked this earth. But could they walk at all, as thus restored? is a question which can scarcely fail to occur to those who look on these wonderful pictures. In most or all other restorations, as in the plate by Smit in Hutchinson's "Extinct Monsters," pterodactyles, when not flying, are shown crawling on rocks or cliffs, or sitting up on their hind legs on some prominence preparatory to taking flight. Prof. Seeley will, however, have nothing to say to such crouching attitudes, and represents the creatures standing on all fours, with the greatly elongated wing-finger bent back

alongside the fore-arm and projecting above the hind-quarters, and the wing folded like an inverted Chinese sun-shade. Whether such slender hind-limbs as are shown in the restoration are capable of supporting the weight of the body in this position we will not pause to inquire. Our difficulty is in connection with the fore-limb, the raising of which would apparently cause the wings to strike against the ground at every step, even if they did not become entangled with the hind-legs. Moreover, the creature is represented as actually standing on the joint between the metacarpus and the wing-finger, and as this joint must certainly have been a highly delicate and complex structure, it appears impossible to conceive how it could have escaped injury in walking if carried in the position shown in the restoration. Possibly the author has an explanation of these difficulties, but if so it would have been more satisfactory had it been given to the public.

To revert, in conclusion, to the main argument of the book, we fully realise the amount of labour that Prof. Seeley has expended on a very difficult subject, and at the same time are prepared to admit the advantage which often accrues to the progress of science from the presentation of opinions widely different from those generally entertained. Nevertheless, we scarcely think that he will persuade those of his readers whose verdict is worth having to agree with him in regarding pterodactyles and birds as in any way near akin, or will convince them that the former creatures are no longer entitled to be classed as reptiles. Aberrant they are, no doubt, but not so much so as, in our opinion, to be excluded from the limits of a class comprehensive enough to embrace such diverse types as dinosaurs, turtles, ichthyosaurs and snakes. As to the alleged relationship between the "dragons of the air" and the egg-laying mammals, we are fain to confess that it requires a greater power of imagination to realise the nature of the affinity than it falls to our own lot to possess.

R. L.

ELEMENTARY DYNAMICS.

Theoretical Mechanics: an Elementary Treatise. By W. Woolsey Johnson, Professor of Mathematics, U.S. Naval Academy. Pp. xv+434. (New York: John Wiley and Sons. London: Chapman and Hall, Ltd., 1901.) Price 3 dollars net.

THE author states in his preface that "the study of mechanics is here supposed to follow an adequate course in the differential and integral calculus." Hence it is difficult to see how it can appeal to any class of students—at least in this country—especially as, in addition to both branches of the calculus, the conceptions of geometry of three dimensions are also introduced at the outset. The student who has already progressed thus far in mathematics does not require to be introduced to the parallelogram of forces and all the elements of the composition and resolution of coplanar forces and velocities. There is nothing distinctively novel in the work, which is, on the whole, a careful compilation from the works of the best writers on the subject, without any acknowledgment of the sources.

The first two chapters deal with forces acting on a particle, and make free use of the calculus and geometry